

# Claims

- [c1] 1. A hybrid electric powertrain for an automotive vehicle comprising:  
an engine, an electric motor, a battery, a generator and transmission gearing;  
the transmission gearing defining in part a first power flow path from the engine to a power output member;  
the generator being mechanically coupled to the engine by the transmission gearing;  
the motor, the battery and the generator being electrically coupled and defining in part an electro-mechanical power flow path to the power output member;  
a generator torque reaction brake means for anchoring the generator when the electro-mechanical power flow path is disabled; and  
a slipping clutch mechanically connecting a torque reaction element of the gearing to the generator whereby a mechanical power flow path from the engine to the power output member is maintained when the electro-mechanical power flow path is disabled.
- [c2] 2. The hybrid electric powertrain set forth in claim 1 wherein the battery is a high voltage battery;

the battery, the generator and the motor forming an electrical power delivery sub-system for satisfying a power demand; and  
a vehicle controller including means for controlling electrical current transfer between the motor and the generator as the battery functions as an electrical energy storage medium;  
the electro-mechanical power flow path being disabled when the battery is in an open circuit state.

[c3] 3. The hybrid electric powertrain set forth in claim 2 wherein the vehicle controller includes means for disabling the generator and the motor when the battery is in an open circuit state.

[c4] 4. A hybrid electric powertrain for an automotive vehicle comprising:  
an engine, an electric motor, a battery, a generator and transmission gearing;  
the transmission gearing defining in part a first power flow path from the engine to a power output member;  
the generator being mechanically coupled to the engine by the transmission gearing;  
the motor, the battery and the generator being electrically coupled and defining in part an electro-mechanical power flow path to the power output member;  
means for controlling generator speed by regulating cur-

rent transfer between the motor and the generator as the battery functions as an electrical storage medium;  
a generator torque reaction brake means for anchoring the generator to effect a mechanical power flow path from the engine to the power output member when the electro-mechanical power flow path to the power output member is disabled; and  
a slipping clutch in a mechanical connection between the engine and the generator whereby a mechanical power flow path is established between the engine and the power output member, reaction torque for the gearing being developed by the slipping clutch.

[c5] 5. A hybrid electric powertrain for an automotive vehicle comprising:

an engine, an electric motor, a high voltage battery, a generator and transmission gearing;  
the transmission gearing defining in part a first power flow path from the engine to a power output member;  
the generator being mechanically coupled to the engine by the transmission gearing;  
the motor, the high voltage battery and the generator being electrically coupled and defining in part an electro-mechanical power flow path to the power output member;  
a generator torque reaction brake means for anchoring

the generator when the electro-mechanical power flow path is disabled;  
a slipping clutch mechanically connecting a torque reaction element of the gearing to the generator whereby a mechanical power flow path from the engine to the power output member is maintained when the electro-mechanical power flow path is disabled;  
a low voltage battery and alternator forming a low voltage power source for the vehicle; and  
an alternator drive clutch means for connecting the alternator to the engine as the slipping clutch is activated.

[c6] 6. The hybrid electric powertrain set forth in claim 5 wherein the high voltage battery, the generator and the motor form an electrical power delivery sub-system for satisfying a power demand; and  
a vehicle controller including means for controlling electrical current transfer between the motor and the generator as the high voltage battery functions as an electrical energy storage medium;  
the electro-mechanical power flow path being disabled when the high voltage battery is in an open circuit state as low voltage needs are supplied by the low voltage battery.

[c7] 7. The hybrid electric powertrain set forth in claim 1 wherein the transmission gearing includes a planetary

gears having a ring gear element, a sun gear element and a carrier element with planet pinions engaged with the sun gear element and the ring gear element;  
the generator being mechanically coupled to one element of the gears and the engine being mechanically coupled to a second element of the gears, a third element of the gears being mechanically coupled to the power output member;  
the slipping clutch defining in part a mechanical connection between the generator and the one element of the gears.

- [c8] 8. The hybrid electric powertrain set forth in claim 2 wherein the transmission gearing includes a planetary gears having a ring gear element, a sun gear element and a carrier element with planet pinions engaged with the sun gear element and the ring gear element;  
the generator being mechanically coupled to one element of the gears and the engine being mechanically coupled to a second element of the gears, a third element of the gears being mechanically coupled to the power output member;  
the slipping clutch defining in part a mechanical connection between the generator and the one element of the gears.

- [c9] 9. A method for controlling a hybrid electric powertrain for an automotive vehicle, the powertrain having an engine, an electric motor, a high voltage battery, a generator and transmission gearing defining in part a mechanical power flow path from the engine to a power output member, the motor, the high voltage battery and the generator being electrically coupled and defining in part an electro-mechanical power flow path to the power output member, the method comprising the steps of: establishing a driving connection between the generator and the engine; braking the generator to provide reaction torque for a reaction element of the gearing as a mechanical power flow path is established between the engine and the power output member; and establishing a variable speed connection between the reaction element of the gearing and the generator when the generator is braked, whereby the engine is allowed to operate at speeds above a stall speed when the mechanical power flow path is established.
- [c10] 10. The method set forth in claim 9 wherein the step of braking the generator occurs in response to disablement of the electro-mechanical power flow path.
- [c11] 11. The method set forth in claim 9 including the step of establishing a low voltage source for the vehicle; and

activating the low voltage source when the generator is braked as a mechanical power flow path is established from the engine to the power output member.